PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 412763	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/US 03/30566	International filing date *(day/month/year)* 26.09.2003	Priority date *(day/month/year)* 27.09.2002
International Patent Classification (IPC) or both national classification and IPC H01S3/00		
Applicant THE TRUSTEES OF DARTMOUTH COLLEGE et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
14.04.2004	20.10.2004
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Lendroit, S Telephone No. +49 89 2399-7637

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US 03/30566

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-12 as originally filed

Claims, Numbers

1-18 as originally filed

Drawings, Sheets

1/7-7/7 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

   ☐ the entire international application,

   ☒ claims Nos. 14-15

   because:

   ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):

   ☐ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. are so unclear that no meaningful opinion could be formed *(specify)*:

   ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

   ☒ no international search report has been established for the said claims Nos. 14-15

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

   ☐ the written form has not been furnished or does not comply with the Standard.

   ☐ the computer readable form has not been furnished or does not comply with the Standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-13, 16-18
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-13, 16-18
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-13, 16-18
	No:	Claims	

2. Citations and explanations

   see separate sheet

The following documents are referred to in this communication; the numbering will be adhered to in the rest of the procedure:

D1: US-A-5 263 043 (WALSH JOHN E) 16 November 1993 (1993-11-16)
D2: US-A-5 790 585 (WALSH JOHN E) 4 August 1998 (1998-08-04)
D3: WALSH J E ET AL: "A new far infrared free-electron laser" NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH, SECTION - A: ACCELERATORS, SPECTROMETERS, DETECTORS AND ASSOCIATED EQUIPMENT, NORTH-HOLLAND PUBLISHING COMPANY. AMSTERDAM, NL, vol. 429, no. 1-3, 11 June 1999 (1999-06-11), pages 457-461, XP004171254 ISSN: 0168-9002
D4: URATA J ET AL: "Superradiant Smith-Purcell emission" PHYSICAL REVIEW LETTERS, 19 JAN. 1998, APS, USA, vol. 80, no. 3, pages 516-519, XP002277686 ISSN: 0031-9007
D5: BAKHTYARI A ET AL: "Amplified-spontaneous-emission power oscillation in a beam-wave interaction" PHYSICAL REVIEW E (STATISTICAL, NONLINEAR, AND SOFT MATTER PHYSICS), JUNE 2002, APS THROUGH AIP, USA, vol. 65, no. 6, pages 066503/1-4, XP002277687 ISSN: 1063-651X
D6: VAN DEN BERG P M: "Smith-Purcell radiation from a point charge moving parallel to a reflection grating" JOURNAL OF THE OPTICAL SOCIETY OF AMERICA, DEC. 1973, USA, vol. 63, no. 12, pages 1588-1597, XP009029663 ISSN: 0030-3941
D7: GOLDSTEIN M ET AL: "Demonstration of a micro far-infrared Smith-Purcell emitter" APPLIED PHYSICS LETTERS, 28 JULY 1997, AIP, USA, vol. 71, no. 4, pages 452-454, XP002277689 ISSN: 0003-6951
D8: US-A-5 268 693 (WALSH JOHN E) 7 December 1993 (1993-12-07)
D9: US-A-4 874 953 (KATZ JOSEPH) 17 October 1989 (1989-10-17)
D10: US-A-4 727 550 (CHANG DAVID B ET AL) 23 February 1988 (1988-02-23)

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

The invention relates to a Far-Infrared Free-Electron Laser using the Smith-Purcell effect and in particular to the definition of the transversal profile of the grating element of the laser.

The diffraction grating element of claim 1 meets the requirements of Article 33 (2) to (4) PCT, for the following reasons:

The grating element of claim 1 distinguishes itself from the grating elements of the prior art documents in that its transversal profile is specially designed as a "horn", i.e. as the flared end of a hollow waveguide.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

The object of the invention is to improve the interaction between grating and electron beam. This problem is solved by the characterising features of claim 1. The transversal profile of the grating element reduces the diffraction effects by enlarging the effective mode area.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

None of the available prior art documents neither discloses nor gives any hints about such a design of the transversal profile of the grating element of a free-electron laser.

Thus the skilled person starting from the grating elements of the available prior art documents would not be motivated to modify them such as to arrive at the grating element of claim 1.

Therefore, the subject-matter of claim 1 can not be derived from the prior art in an obvious way.

The grating of claim 2 meets the requirements of Article 33 (2) to (4) PCT for the same reasons as stated above.

Furthermore claims 11 and 18, which are related to systems comprising the grating element according to the invention are also not obvious in the light of the prior art for the

same reasons as stated above.

Furthermore claim 16, which is related to a method of using the grating element according to the invention, is also not obvious in the light of the prior art for the same reasons as stated above.

Claims 3-10, 12-13, 17 are dependent on claims 2, 11, 16 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

Remarks:

A. The application does not meet the requirements of Article 6 PCT, because **claims 1,2,11,16,18 are not concise and not clear.**

Although these claims have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore **lack conciseness** and as such do not meet the requirements of Article 6 PCT.

Moreover, **lack of clarity** of the claims as a whole arises, since the plurality of independent claims makes it difficult, if not impossible, to determine the matter for which protection is sought.

It would have been appropriate to file a set of claims defining the relevant subject-matter in terms of a single claim in each category followed by dependent claims covering features which are merely optional (Rule 6.4 PCT).

B. The application does not meet the requirements of Article 6 PCT, because **claims 2-11, 13, 16-18 are not clear.**

The expression "**grating horn**" used in claims 2-11, 16, 18 is not clearly understandable and should have been more precisely defined.

The expression "**vertex**" used in claims 3, 5-7 is not clearly understandable and should have been more precisely defined.

For the sake of clarity, the abbreviation "**FIR**" used in claims 11, 13, 16-17 should have been replaced by the expression "far infrared".

Moreover each claim must be clear by itself. It is not sufficient to determine the meaning and scope of the words used in the claims by merely using the description

and/or the drawings. The technical features defined by the words used in the claims should be directly and unambiguously derivable and should leave no clarity problems in order to clearly limit the scope of invention.

C. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).
The features of the claims should have been be provided with **reference signs** placed in parentheses to increase the intelligibility of the claims (Rule 6.2(b) PCT).

D. The unit micron employed in the description does not belong to the SI units. It would be appropriate to replace it by micrometre.

E. In the description of the present application, reference is made on pages 1, 4-6,11-12 to Patent Applications, Patents and documents, using the following usually used expression "incorporated by reference".

If matter in the documents referred to is essential to satisfy the requirements of Article 5 PCT, it should be expressly incorporated into the description, because the patent specification should, regarding the essential features of the invention, be self-contained, i.e. capable of being understood without reference to any other document.

If not, this expression **"incorporated by reference"** should be deleted from the description (see PCT International Preliminary Examination Guidelines 4.26).

F. Reference numeral 25 used in the description does not appear in the drawings.